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ENTOMOLOGY AS A PURE SCIENCE*

By E. W. BERGER

My chief concern about this society and its publication (THE FLORIDA BUGGIST) is that it should always reflect Entomology as a true science, as distinguished from Applied Entomology or Economic Entomology. From the nature of our organization, we shall not need to worry about the applied side not being duly represented, for we are practically all economic entomologists, or near-entomologists, or otherwise interested in insects that injure crops. But, if for no other reason than for the sake of those in our organization whose training in entomology has been limited, I believe that we should make every effort to present some papers and articles having a bearing upon the science of entomology in its broader aspects. For instance, Prof. Watson's paper on The Thysanoptera of Florida (THE FLORIDA BUGGIST, Vol. I, No. 4 and Vol. II, No. 1) is such a paper, it being a distinct and permanent contribution to the science.

There was a time, perhaps not a hundred years ago, when science was studied for the sake of knowing, for the information that it yielded about the natural things surrounding us, and the pleasure it afforded to the few. More recently, however, it has become the business of mankind to apply scientific knowledge of all kinds in every-day affairs so that men and institutions have arisen whose primary object it is to make science practical. This condition of affairs has caught the attention of the public and the business man, so that pure science has stood in danger of being neglected. But it is apparent to the thoughtful that in order to

*Paper read before the Florida Entomological Society, Dec. 17, 1917.

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keep up the supply of new ideas, principles and knowledge for the workers in applied science, the investigations in pure science must be continued. In other words, if new ideas, new principles, new facts were not being brought out continually, the worker in applied science, including economic entomology, would soon be at a standstill.

As an illustration of the importance of isolated and apparently insignificant facts and principles, the development of another science appeals to me, and I believe that this also lends itself better as an illustration.

As an example of the slow accretion of knowledge, sometimes accidental, sometimes fostered studiously by individuals, later by groups of men and students at universities and other seats of learning, and finally by institutions established for the purpose, until the few scattered facts, at first apparently useless and largely curiosities, became developed into a system of related facts and principles, I love to think of the science of electricity and magnetism. From static electricity, generated by rubbing a piece of amber (a fact known to the ancient Greeks 600 B. C.), to the modern telephone, the dynamo and motor, the X-ray, and finally, the wireless, is a far cry. However, any one who knows something of the facts, I am sure, will subscribe to the statement that the modern electric locomotive, for instance, was presaged by the apparently trivial and curious electrical phenomena known to the Greeks, the inventions of the Italians, Galvani and Volta, and later in the coils of wire and magnets of Faraday. I love to think of it, that the germ of the electric motor and dynamo was present in the very simple experiment of the deflection of a magnetic needle by means of an electric current passed thru a wire near it. This simple experiment first demonstrated the relationship between magnetism and electricity, and while apparently useless knowledge then, was a ready-made fact for Faraday and others, so that today we have all kinds of electrical apparatus and machinery serving mankind.

Coming back to our own subject of entomology, the classifications of insects and the studies on structure, particularly of the mouth-parts and their uses, and the manner in which insects breathe, were the foundation on which those who were devising methods for destroying insects could build. While no doubt successful attempts at destroying injurious insects were made by those having no particular knowledge of insects, the process could only be carried on with understanding by those knowing

something of the structure and life history of the insects that they desired to destroy. As an illustration of the futility of blind effort in an attempt to control an insect, I have in mind the spraying operations against the citrus whiteflies in Florida. Power sprayers were bought and an attempt made to spray the groves in a whole county (Orange County, 1906) regardless of the time at which the fly was most susceptible to sprays, with the result that spraying was once more condemned as a failure. The facts were known to the entomologists that had been in the State prior to that time, but whether these facts had not been sufficiently featured in the bulletins or were ignored by the parties undertaking the spraying, I cannot advise. At all events, the whitefly of citrus is now successfully controlled by spraying.

To sum up this part of my paper, it is apparent that no facts, ideas, principles or laws, tho apparently insignificant and useless at the time of discovery, are useless, but will eventually be applied in the life of mankind. The world can never know whether a fact is economically useful and important until it finds out, and for that the world may need to wait a thousand years.

From motives of a pure desire to know, any one could study insects (I mean the insects themselves, not books) from the following points of view; in fact each point of view is a science by itself: Taxonomy; Morphology; Ecology; Psychology—behavior, instincts; Paleontology.

TAXONOMY OF INSECTS

This includes description and classification of insects into orders, sub-orders, families, genera, species, and sometimes varieties. (I should perhaps explain that the term Taxonomy means classification, and is used in the same sense whether applied to the classification of insects, other animals or plants.) This phase of entomology has probably been more extensively studied than the others, and was for a considerable period of the last century the principal subject of insect study. Classification may also have been the very first phase of entomology to engage students of nature. It would only be natural to arrange a collection of insects into groups according to their likenesses and give the groups names. Aristotle was apparently the first to leave a record of this kind. He made a classification of animals, and his classification of insects is only a part of the whole.

MORPHOLOGY

Morphology is the study of form and structure of animals, and logically it should precede classification, as classification is based upon form and structure; but in point of time it largely followed classification, which was then based mostly upon the external characteristics only. Studies of form and structure naturally bring out relationships, and, thanks largely to morphology, we now have classifications of insects, and other animals, that represent more nearly true relationships.

It will be quite apparent that the form and structure of an insect, or other animal, or plant, may be studied from three points of view: Anatomy, Histology, Embryology.

Anatomy.—This consists in the study of the organs, or larger units of an animal. We may speak of the external anatomy and the internal anatomy. External atanomy deals with the shape, structure and relative positions of the external organs: wings, mouth parts, head, legs, eyes, etc., of an insect; internal anatomy with the internal organs.

Histology.—Histology is the structure of living things as manifested by the microscope. From this we learn, for instance, that the organs and parts of insects are made up of microscopic cells, or units, similar to those of other animals and plants.

Embryology and Life History.—A tracing of the development of an animal, be it insect, bird or mammal, prior to its birth or hatching from an egg is called embryology. It may be stated here that some insects are born alive. The complete life history of an animal consists of its several developmental stages, including its embryology. Specifically, in most insects, it includes the following stages or states of development: egg, embryo, larva (grub, caterpillar, maggot, etc.), pupa, and adult. For the study of embryology a compound microscope and other special apparatus is necessary, as well as a knowledge of special methods to preserve the many delicate and microscopic structures found.

ECOLOGY

When a naturalist, whether entomologist or other investigator, studies insects or other organisms inhabiting certain localities in an endeavor to solve their mutual relations to each other and to their environment, we have the science of ecology, meaning, literally, a study of the household.

PSYCHOLOGY: BEHAVIOR, INSTINCTS

This title is quite self explanatory as to its subject matter. The habits and instincts of insects are varied and have been extensively studied. This is especially true for ants, bees and wasps.

The definition of psychology is science of mind, and it may be questioned whether insects have mind, as this term is ordinarily used. The writer, nevertheless, prefers to retain the term, psychology, as it is difficult to believe that there should not be some form of mind involved in all the manifold activities of insects.

PALEONTOLOGY

The study of the remains (fossils) of living things found in the different layers of rock and earth forming the earth's crust is called paleontology. The fossil insects found indicate profound changes in the insect life of this earth during its successive geological periods. Of unusual interest are the insects found embedded in the fossilized accumulations of resin known as amber. Paleontology shows that insects as a whole are, geologically speaking, a recent group. Their soft, or at best chitinized bodies do not readily form fossils and so it happens that, as compared with animals having bony and calcareous parts, their past is poorly preserved.

ECONOMIC ENTOMOLOGY

MEDICAL ENTOMOLOGY

These two sciences were not included in the preceding list because they deal directly with the practical application of entomological knowledge to human affairs. They draw largely for their information upon the phases of entomological science previously noted, altho each has its own problems to solve and investigations to make, and each is just as scientific as the other. The former, however, are regarded as in the realm of pure science, in which the practical application of the results is not necessarily considered, whereas the latter (the subjects of this topic) are in the realm of applied science, where the practical application of results obtained is the primary object.

STRATEGUS WANTED—Am making a special study of this genus, of the Scarabeidae, and should be very glad to receive Florida specimens, especially of the rarer species. Will exchange or pay cash. Address W. Knaus, McPherson, Kansas.

REPORTS OF MEETINGS

June 24. Visitors present were Professor Carl J. Drake, Associate Professor of Entomology, The N. Y. State College of Forestry, Syracuse University, Syracuse, N. Y., and Mr. Geo. F. Arnold, Nursery Inspector, State Plant Board of Mississippi.

Under "Timely Notes" Prof. Watson reported that stink bugs and pumpkin bugs were attacking fruit unusually early this year.——In answer to a question by Dr. J. H. Montgomery, Prof. Watson advised that the Whitefly Ladybeetle *(Delphastus catalinae)* received by him from the State Insectary of California, and introduced into several places in Florida, was reported as having become established at Bradentown, but that he had not been able to go and verify the report.

In the first paper of the evening, "Insects and the Optimistic Grower", Mr. F. M. O'Byrne, Inspector of Nursery Stock, noted some personal experiences and made some suggestions valuable to those whose lot it becomes to recommend treatment for insects or diseases. Some growers will follow the advice of the last visitor rather than of the man supposed to know. Others, the optimistic kind, discount all recommendations made. In such instances, reference to concrete results obtained by others who had the same insects or diseases in their trees are most convincing. In general, advice given should anticipate mistakes growers may make and be followed by a second visit if possible. Recommendations should preferably be in written form in which necessary details should be stressed.

The second paper of the evening, "Storage and Fumigation of Corn and Other Seeds for Weevils", was by Mr. R. L. Clute. Mr. Clute first briefly referred to the kinds of insects generally found infesting stored plant products in Florida, and then showed plans for the proper storage of corn, etc., in which fumigation for insects can be properly done. The importance of storing corn without the husks was particularly emphasized, as it requires less room for storage and less carbon bisulphide for fumigation. Several photographs of good storage houses in use in Florida were also exhibited. Mr. Clute is embodying the subject matter of this paper in a practical bulletin for farmers and others.

In a third paper of the evening, "The Purse Spider and Two Rare Tingids", Professor Drake gave some very interesting information. The Purse Spider, supposed to be of rare occurrence, was found by Prof. Drake to be quite common at Gainesville,

Fla. He had previously taken a specimen from a frog's stomach at Cedar Point, Ohio. A colony of these spiders has been reported at Washington, D. C., and Professor J. H. Comstock collected it at Lake City, Fla., some years ago.——The first tingid in question is *Teleonemia belfragei*, now very common on *Callicarpa americana* (French mulberry) on the University campus and vicinity at Gainesville. Previously reported only from the West Indies, *Callicarpa* is furthermore a new host for this tingid. ——The other tingid is *Dichocysta pictipes*, of which Prof. Drake collected two specimens in the hammock on the University campus. This species had previously not been collected east of Arizona in the United States, but is found in Mexico.

July 22. Visitors present were Miss Isabelle Mays, Instructor in Mathematics, University Summer School, and Mr. E. L. Robinson, Asst. Principal, Public Schools, Tampa.

Professor Carl J. Drake, School of Forestry, Syracuse University, N. Y. State, and Mr. E. L. Robinson were elected to the membership of the Society.

Under "Timely Notes" Professor Drake reported a new species of Fulgorid (Lantern-fly Family) on gallberry and huckleberry about Gainesville, Fla.——Professor Watson reported on the successful use of Kansas bait on the Fall Army Worm *(Laphygma frugiperda)* on a property south of the University grounds, and that army worms were general over the State from Miami to Bonifay and Chipley.——Mr. Geo. B. Merrill reported briefly an outbreak of the Fall Army Worm just north of Gainesville, advising that the same was controlled in part by dusting zinc arsenite and calcium arsenate and in part by plowing furrows to keep the worms back.

In the first paper of the evening, Plant Commissioner Wilmon Newell described an outbreak of the Banana Root Borer *(Cosmopolites sordidus)* in South Dade County. Thirty-four properties were inspected from January 6 to 19, of which seven were found infested. This beetle had been declared a public nuisance by the Plant Board only in the December (1917) preceding. Eradication work was at once begun by digging and burning the plants. Split banana stems were used as baits in the fields and large numbers of the beetles caught and destroyed. This beetle is a pest in Cuba, Jamaica, British Guiana, islands of the South

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DR. E. W. BERGER.....Associate Editor, Acting Business Manager
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Fumigation of citrus trees may be revived in Florida. The Roessler and Hasslacher Chemical Company is conducting extensive demonstrations at Windermere and elsewhere in Florida. Improved methods of generating and discharging the gas under the tents by means of a machine greatly simplify and shorten the operations. Particulars may be obtained by addressing Mr. J. B. Dales, Pine Tree Inn, Windermere, Fla.

THE CALIFORNIA DELPHASTUS

The whitefly-eating lady-beetle *(Delphastus catalinae)* continues to multiply in several Florida groves at a most gratifying rate. In the grove near Bradentown they are present in countless thousands and arrangements have been perfected for shipping these beetles from there to different parts of the state. It is desired to introduce them into all citrus communities. It is thought that enough are now in sight to supply a colony to any grower who desires one. Anyone interested should apply to his county agent or to the Department of Entomology of the Experiment Station. A small charge, sufficient only to defray the cost of collecting and packing, is made for these.—J. R. W.

AN OUTBREAK OF THE COTTON STAINER ON CITRUS

Citrus and avocado growers in some of the southern counties of the state where, in order to escape the boll weevil, cotton has been raised this season, are having trouble with the Cotton Stainer *(Dysdercus saturellus* (H. S.)). This bug is a pyrrhocorid with deep red body and black wings and is sometimes called the "red bug." This is a common name for the cotton stainer in the West Indies and would be appropriate and desirable for Florida were it not preoccupied by those pestiferous mites, the larvae of Trobidium, with which we are all too well acquainted.

On citrus the cotton stainer does about the same type of dam-

age as the pumpkin bug *(Nezara viridula)*, i. e., it punctures the rind and the fruit soon drops from the tree and decays. The punctures, however, are smaller and entirely invisible to the naked eye. There is not the hardening and discoloration of the surrounding tissue characteristic of pumpkin bug injury. The bugs feed mostly on the oil cells but frequently penetrate to the pulp. They are much more restless than the pumpkin bugs and do not remain feeding in one spot for hours as the latter frequently do. They show the same preference for thin-skinned varieties of citrus, tangerines being their first choice. They are not as apt to feed all night as are the pumpkin bugs, but usually collect in colonies on the interior of the tree. Even in the day time they are distinctly gregarious, collecting in colonies on the leaves and fruit both on the tree and the ground.

The present outbreak has undoubtedly been brought on by the planting of cotton in citrus communities. No outbreak has been recorded in communities where no cotton was planted. The adults can fly considerable distances. The writer recently saw one heavily infested grove that was three-fourths of a mile from the nearest cotton. There were adults only in this grove. Another grove directly across a road from a cotton patch was heavily infested with both adults and young. Scattering half grown nymphs were seen as far as 800 feet from the cotton. The vast majority of these had crawled from the cotton field. Indeed, scores were observed in the act of crawling across. They travelled in a nearly straight line for the citrus as if they smelled it, altho the wind was from another direction. However, one colony of very young nymphs was observed that must have hatched from eggs laid on fallen oranges. The nymphs were but a few days old and were bunched in a compact colony after the fashion of newly hatched nymphs of these bugs. It is incredible that the colony could have crawled *en mass* such a distance without becoming scattered. A search was made for Spanish cockle-burr on which they might have bred but none was found. Evidently, they can occasionally breed on citrus, altho Hubbard states that they do not do so.

Evidently the growing of cotton in citrus communities in the southern counties should be abandoned. Altho the bugs are rather sporadic in their appearance, being abundant some years and scarce others, the practice involves too great a risk. Hubbard, in "Orange Insects", warns against the practice. Another statement that he makes, however, is erroneous, or at least only

partly true. He states that chickens will not eat the bugs. The writer saw chickens gorging themselves on the bugs, both nymphs and adults. The chickens had saved a portion of a cotton field nearest a house from destruction. It is easy to make a mistake like this in regard to the food of chickens. Fowls are often rank "standpatters", refusing absolutely to even taste a food to which they are unaccustomed. Probably it would frequently happen that a handful of cotton stainers thrown to fowls that had never eaten this species of bug would at first be refused. The writer has had a similar experience with pumpkin bugs which are usually eaten by hens. Indeed he once owned a flock of hens which persistently refused to touch perfectly good Kaffir corn.

The cotton stainer is a southern species and usually does severe damage only in the southern part of the state. Indeed Barber, in his list of the "Hemiptera of Florida", does not record it from north of Lake City and St. Augustine. The absence of any reports from the northern counties, however, is probably due to the absence of entomologists rather than the absence of the bugs, as it is recorded as a pest of cotton in South Carolina, Georgia, and Alabama. It has been recorded from many places in Florida not in Barber's list (see Sellards in Rep. of Fla. Ag. Exp. Station, 1905). Apparently in the compilation of this list, as in some others of the series of lists published by the American Museum of Natural History, the literature of economic entomology has been largely ignored.

Two other species are listed by Barber as having been taken in the extreme southern part of the state. One of them, and at least two other species of the genus, are severe pests of cotton in the West Indies. One of these, *D. delanneyi* Seth., has "been rendered negligible" in St. Vincent by the destruction of its wild hosts, the silk cotton tree, the wild okra *(Malachra capitata)*, and the John Bull tree. Perhaps the same happy result could be achieved in Florida by the destruction of the Spanish cockle-burr *(Urena lobata)* on which it largely breeds in the absence of cotton.

The name "cotton stainer" is derived from the effect of these bugs on cotton lint. They feed on the seed and collect on the bolls in the fields, staining the lint a pinkish or reddish color, greatly lowering its value. This staining is said (West Indian Bulletin XVI No. 3, p. 236) to be due not directly to the bugs but to fungi and bacteria which follow.—J. R. W.

REPORTS OF MEETINGS

(Continued from page 87)

Pacific and India. The infestation was traced to a nursery on the West Coast.

"Pumpkin Bugs", the second paper of the evening, was read by Professor Drake, who was then investigating the habits and life history, but especially the insect enemies of these bugs. Professor Drake suggests the common name of Southern Green Stink Bug for *Nezara viridula* to distinguish it from *Nezara hilaris* which is the commoner species farther north but also found here. *N. viridula* is in northern Africa, Asia, and other parts of the world. *N. marginata* and *N. pennsylvanica* are also in Florida but rare. Radish is the favorite food of these bugs in spring and is suggested as a trap crop to protect other plants and vegetables. Cowpeas are also much attacked.——The egg masses of *N. viridula* average 80-90 eggs and hatch in 4-5 days. There are 5 instars, or stages, i. e., there are 5 sizes of the bugs, counting the newly hatched and including the full grown bugs. The life cycle is 4-6 weeks in summer. *N. viridula* has its share of natural enemies, including the Wheelbug, Tachina Flies, Sarcophagidae, and egg parasites. The Tachina Flies and Sarcophagidae are flies resembling houseflies, but are more hairy, and it is the maggots of these flies that infest the bugs.

Both of these papers were discussed by those present.

August. No meeting was held because so many of the resident members were absent from Gainesville on account of professional duties.

September 30. Twenty-seven visitors were present from among those who were attending the Citrus Seminar and the Live Stock Roundup at the University.

The first paper of the evening was by Mr. W. L. McAtee of the U. S. Biological Survey. Mr. McAtee gave a very instructive account of the different lines of work conducted by the Survey. These include investigations of the useful and injurious mammals and birds of the United States, habits and distribution of North American animals, enforcement of federal laws pertaining to importations, quarantines, etc., and a game law section. The Society's interest, however, was centered mainly upon the methods of identifying insect remains in bird's stomachs. This is a very difficult task, but not impossible, since there are certain

hard parts of insects, such as jaws, that admit of fairly accurate identification. Brief accounts of the insect diet of such birds as the bullbat, swallow, quail, oreole, flicker, etc., were given. Thus, the quail, swallow and oreole are undoubted enemies of the Boll Weevil. 5000 ants were found in the stomach of a single flicker. The Boll Weevil is eaten by 66 kinds of birds, the Gypsy Moth by 45 kinds, and leaf-hoppers by 200 kinds.

The second paper of the evening was a round table discussion of common names of insects, led by Professor J. R. Watson. While common names are of practically no value to the entomologist whose requirements are wholly met by the scientific names, it is recognized that common names are needed when discussing insects with growers and others who are generally not familiar with the use of scientific names. The trouble with common names, however, is that there may be several of them in use at the same time or in different localities for the same insect, and it is apparent that in written articles at least, some one name should be selected and used and not a different one in each article. Thus *Nezara viridula*, commonly known as the Pumpkin Bug, is also called the Southern Green Plant Bug, while the name Southern Stink Bug has been suggested. Again, *Selenaspidus articulatus* is known as the West Indian Red Scale, or Rufous Scale. It being apparent that, in order to secure uniformity in common names and to avoid the duplication of such, some one should be recognized as authority to indicate the preferred common names. To further this end, it was voted, on motion of Mr. Wm. Somme, that the President appoint a committee of three on common names of insects. Appointed were J. R. Watson, E. W. Berger and Dr. J. H. Montgomery. It will be the duty of this committee to report to the Society from time to time lists of the preferred common names of insects for publication in THE BUGGIST. Discussion was continued at the next meeting.

Approximately 300,000 species of insects have been described and named and there are probably five times as many more.

WANTED—Diurnal Lepidoptera of Florida in exchange for desirable western species. Over 3000 butterflies on hand for exchanges. Dr. John A. Comstock, Southwest Museum, Los Angeles, Calif.

KATYDID

Thou art a female, Katydid!
I know it by the trill
That quivers through thy piercing notes
So petulant and shrill.
I think there is a knot of you
Beneath the hollow tree,
A knot of spinster Katydids—
Do Katydids drink tea?

(O. W. Holmes—To an Insect.)

It is stated that over 150,000 species of beetles have been described in the world.

FLORIDA ENTOMOLOGICAL SOCIETY

Organized to further the discovery and dissemination of knowledge about insects, especially Florida insects. The Society appeals to all those interested to join and assist. It is the only organization of its kind in Florida and the South. Your membership will strengthen the Society and THE FLORIDA BUGGIST, its official publication. Annual dues are $1.00, which includes THE BUGGIST. The headquarters of the Society is Gainesville, Fla. The regular monthly meetings are held on the 4th Monday of each month in Science Hall, University of Florida, from 4:30 to 6 p. m.

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